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(54) Title: MINERAL FIBRE

(57) Abstract

The invention concerns a mineral fibre with high temperature resistance and elasticity. The mineral fibre has the following composition in % by weight: SiO_2 38–47, Al_2O_3 16–20, TiO_2 0–4, MgO 5–15, CaO 14–22, $Na_2O + K_2O$ 0–6, iron ($FeO + Fe_2O_3$) 3–10, P_2O_5 0.5–4, other 0–4.

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Mineral fibre

The object of the present invention is fiberizable mineral composition as well as mineral fibres made therefrom, which have a high temperature resistance.

Mineral fibres made by melting and centrifuging of mineral raw materials, such as stone, slag or the like, are extensively used for the manufacture of mineral fibre mats and blankets, primarily for heat and sound insulation purposes within the construction industry. In addition to the manufactured mat exhibiting good insulation properties against heat and sound, in recent times one has started to pay increasingly more attention to the properties of the mat also from the point of view of labour hygiene.

A wide range of insulation products are available on the market, which products do not only exhibit different heat insulation properties, but also a varying degree of temperature resistance. Temperature resistant mineral fibre products are products which can resist increased temperatures during prolonged periods of time without changing form or dimensions to any higher degree. Such products are thus attractive from a fire protection point of view.

Conventional glass fibre has a temperature resistance at temperatures up to appr. 550 °C, whereas the temperature resistance of conventional rock wool is better, up to appr. 700 °C. However, there is an interest for products having an even higher temperature resistance, up to 1100 - 1200 °C, and such products are also available on the market.

Such temperature resistant fibre products contain as the main oxides silicium oxide SiO_2 and aluminium oxide, Al_2O_3, and, in addition, often also an earth alkali metaloxide, such as calcium oxide, CaO, or magnesium oxide, MgO. In addition, such products can contain varying degrees of other oxides, such as titanium oxide, TiO_2, manganese oxide, MnO, boron oxide, B_2O_3, zirconium oxide, ZrO_2, chro-

mium oxide, Cr_2O_3, the alkali oxides sodium and potassium oxide, Na_2O, K_2O, as well as impurities. As examples of relevant prior art in this respect reference is made, for example, to US 4,461,840 and DE-OS 1 496 662.

Such temperature resistant fibre products generally contain an increased amount of Al_2O_3, and often relatively high amounts of iron oxide, FeO and Fe_2O_3. The presence of iron is due to the fact that many economically attractive raw materials contain iron to higher or lesser degree. However, the presence of aluminium and iron in large amounts makes the fibre brittle and unelastic, which makes the fibre difficult to handle.

According to the invention it has now been shown that this disadvantage can be eliminated by including phosphorus in the fibre. The addition of phosphorus increases the elasticity and tenacity of the aluminium and iron containing fibre. This in turn leads to improved handling properties for the fibre products. As the fibre products can be compressed elastically, the need for space, for example, during storing and transport, decreases. As a consequence of the elasticity the product regains its original shape after the release of the compression, and in use well fills all spaces in the building construction. In addition, the tendency for dust formation decreases due to the decreased fibre brittleness. It has also become evident that it is possible to use an increased concentration of alkalis in such fibres, which can be of advantage in certain applications.

More specifically the invention is directed to a mineral fibre which contains the following components in % by weight

SiO_2	38 - 47
Al_2O_3	16 - 20
TiO_2	0 - 4
MgO	5 - 15
CaO	14 - 22
$Na_2O + K_2O$	0 - 6
iron ($FeO+Fe_2O_3$)	3 - 10
P_2O_5	0.5 - 4
other	0 - 4

The term "other" components means such possible contaminants which are not of essential importance for the properties of the manufactured fibre.

It is known that within the range 0 - appr. 15 % the aluminium oxide concentration is directly proportional to the stability of the fibre in biological solutions, that is, the more aluminium oxide the composition contains, the more stable or poorly soluble the product is. However, this tendency is reversed at a higher concentration so that the solubility of the fibre is increased with the aluminium oxide concentration. Thus, according to the invention a fibre has been obtained which has good heat resistance, good elasticity and high solubility in biological solutions.

In the above mentioned composition, MgO is preferably 5 - 12 % by weight.

According to an advantageous embodiment the invention is directed to a mineral fibre having substantially the following composition in % by weight:

SiO_2	40 - 44
Al_2O_3	16 - 20
TiO_2	0 - 4
MgO	8 - 12
CaO	16 - 22
$Na_2O + K_2O$	2 - 5
iron ($FeO+Fe_2O_3$)	3 - 8
P_2O_5	0.5 - 2
other	0 - 4

The fibre according to the invention is made in a conventional manner by mixing suitable raw materials such as stone, slag, bauxite, dolomite, apatite, anorthosite, glass or different slags and other suitable waste materials in suitable proportions, either as such or as briquettes. The raw materials are then melted, for example in an electrical or cupola furnace, and then made into fibres in any conventional manner, for example by cascade centrifugation of the melt and collecting the fibres on a conveyor.

The following examples illustrates the invention without restricting the same.

Example 1

The following components having the compositions indicated in the following table, were charged in a cupola furnace in the amounts indicated in % by weight.

	Apatite containing peridotite	Dolomite	Gabbroanortho-site
amount: component: % by weight	32	20	48
SiO_2	45.5	8.0	45.6
Al_2O_3	9.9	1.6	30.1
TiO_2	1.8	0.2	0.2
MgO	11.4	17.8	2.3
CaO	13.7	30.1	16.9
$Na_2O + K_2O$	4.5	0.6	1.5
iron	9.7	1.7	2.7
P_2O_5	2.2	0.1	0.0
loss on ignition	1.4	39.9	0.7

Fibres were made by cascade centrifugation in a conventional manner from the obtained melt, which fibres were collected on a conveyor to form a mineral fibre mat. The mineral fibres had the following composition in % by weight

SiO_2	42.0
Al_2O_3	19.0
TiO_2	1.0
MgO	10.0
CaO	19.0
$Na_2O + K_2O$	3.0
iron ($FeO+Fe_2O_3$)	4.0
P_2O_5	1.0
other	1.0.

Example 2

By choosing suitable raw materials, on the one hand fibres according the invention (fibre A) as well as a comparison fibres (fibre B) were made in the same way as described in the Example 1. The fibres obtained had the following composition in % by weight:

	A	B
SiO_2	42.1	43.9
Al_2O_3	18.7	19.6
TiO_2	1.7	0.6
MgO	10.4	11.3
CaO	15.8	17.0
$Na_2O + K_2O$	2.9	1.7
iron ($FeO+Fe_2O_3$)	6.8	5.7
P_2O_5	0.8	0.05
other	0.8.	0.2

The fibres A and B contain approximately the same amount of aluminium oxide plus iron oxide, but fibre B contains only an insignificant amount of phosphorus, whereas that of fibre A is within the limits of the invention.

The compressibility of a fibre mat having a density of 27 kg/m^3 made from the fibres A and B respectively, was then measured in the following way. A test specimen (size 30 x 30 cm) of the mat made from the fibres A and B, respectively was compressed in a compressing device between two plates to a thickness corresponding to 20% of its original thickness. The test specimen was kept in the compressed state for 5 minutes, whereafter the compressive force was released and the specimen was allowed to return to its original form for appr. 1 min. The test mat from fibre A according to the invention showed a recovery in this test of 93-94% (after pressure release, the specimen regained 93-94% of its

original thickness) which is a normal value, whereas that of the comparison fibre B was 89-91%, which value is close to the limits of acceptability. Thus the test results show that when the mat made from the fibre A according to the invention has a better compressibility than the reference fibre B.

Claims

1. Mineral fibre, **characterized** in that it has the following composition in % by weight:

SiO_2	38 - 47
Al_2O_3	16 - 20
TiO_2	0 - 4
MgO	5 - 15
CaO	14 - 22
Na_2O + K_2O	0 - 6
iron (FeO+Fe_2O_3)	3 - 10
P_2O_5	0.5 - 4
other	0 - 4

2. The mineral fibre according to claim 1, **characterized** in that in the composition, MgO is 5 - 12 % by weight.

3. The mineral fibre according to claim 1 or 2, **characterized** in that it has substantially the following composition in % by weight:

SiO_2	40 - 44
Al_2O_3	16 - 20
TiO_2	0 - 4
MgO	8 - 12
CaO	16 - 22
Na_2O + K_2O	2 - 5
iron (FeO+Fe_2O_3)	3 - 8
P_2O_5	0.5 - 2
other	0 - 4

4. Method for increasing the elasticity and decreasing the brittleness in a mineral fibre, **characterized** in that to a mineral composition containing the oxides SiO_2, MgO and CaO, and in addition aluminium oxide in an amount of 16-20 % by weight and iron oxides in an amount of 3-10 % by weight, phosphorus is added in the form of an phosphorus containing compound in an amount of 0.5-4 % by weight, calculated as P_2O_5, a melt is formed from the composition, which melt is fiberized to fibres with increased elasticity and decreased brittleness.

5. The method according to claim 4, **characterized** in that to a mineral composition containing in % by weight

SiO_2	38 - 47
Al_2O_3	16 - 20
TiO_2	0 - 4
MgO	5 - 15
CaO	14 - 22
$Na_2O + K_2O$	0 - 6
iron ($FeO+Fe_2O_3$)	3 - 10
other	0 - 4

a phosphorus-containing compound is added in amount of 0.5 - 4 % by weight, calculated as P_2O_5.

6. Product, **characterized** in that it contains a fibre according to claim 1, 2 or 3, or is made according to the method of claim 4 or 5.

7. The product according to claim 6 in the form of a mat or blanket or a tubular bowl, especially for heat and/or sound insulation.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 98/00632

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: C03C 13/00, C03C 13/06
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: C03C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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A	WO 9614274 A2 (ROCKWOOL INTERNATIONAL A/S), 17 May 1996 (17.05.96), page 8, line 30 - page 9, line 8, claim 2 --	1-7
A	FR 2662687 A1 (ISOVER SAINT-GOBAIN SOCIETE ANONYME), 6 December 1991 (06.12.91), page 5, line 5 - line 7, claim 1 --	1-7

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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